LAND USE ASSESSMENT

MOUNTAINTOP MINING IN WEST VIRGINIA

DRAFT REPORT

LAND USE ASSESSMENT

MOUNTAINTOP MINING IN WEST VIRGINIA

DRAFT REPORT

PREPARED BY:

Charles Yuill
West Virginia University
Natural Resource Analysis Center
Davis College of Agriculture, Forestry, and Consumer Sciences
Agricultural Sciences Building
Morgantown, West Virginia 26505 – 6108.

February 2002

Table of Contents

Introduction

Scope

This study was conducted to examine land use issues associated with mountaintop mining in southern West Virginia – the mountaintop-mining region of the state. For this study, the mountaintop-mining region is defined as the fourteen county area illustrated in Figure 1. These fourteen counties represent counties that historically have contained mountaintop-mining operations and / or have coal reserves that are suitable for recovery with future mountaintop mining. Also for this study:

- Land use is defined as a purposeful intended use of the land – e.g. commercial forestry or outdoor recreation.
- Land cover is defined as the physical component of the land – e.g. mature trees or grassland.
- Land use / land cover is an approach to classification of land use and land cover that considers both perspectives within a single classification framework.

Mountaintop mining is defined as a surface mining method that is designed to mine multiple seams of coal by mining either parallel to or cross mountain ridges – removing all of the coal in and above a base coal seam. The mining method generally results in the following conditions:

- Complete or near-complete removal of a mountaintop resulting in significant quantities of spoil material which must be returned to the mined area as backstacked fill or placed in adjacent valley fills.
- Efficient recovery of the coal reserves in and above the base coal seam.
- Because of the above, the resulting mines are generally significantly larger than with the various forms of contour mining that are practiced in the steep slope mining region of southern West Virginia.

The overall goal of the study was to identify and assess the major land use impacts of current and potential mountaintop mining in the region. To meet this goal, the study was structured with the following components:

- Current land use / land cover (lu / lc) patterns in the region to establish baseline land use conditions in the region.
- General historic land use / land cover trends.
- The contributions of past and current coal mining in determining land use and land cover patterns in the region.
- The roles various land use programs and regulatory controls contribute to land use development on mountaintop mines, as well as the region in general.

- Characterization of development patterns, opportunities, and limitations in the region to place land use opportunities and problems associated with mountaintop mining in a larger regional perspective.
- Identification of current land use / land cover patterns and conditions in areas with potentials for future mountaintop mining to assess potential land use impacts of future mountaintop mining in the region.
- Discussion of a few case studies to identify the conditions that contribute to the development of both typical and atypical land uses on mountaintop mines.

The Study Area

The fourteen county study region comprises part of the Appalachian Plateau, which is a maturely dissected plateau characterized by high hills, sharp ridges, and narrow valleys. Exceptions are portions of the Kanawha River Valley and Teays Valley, which have expanses of open relatively level floodplain lands. Local relief in the region exceeds 2,000 ft along the New River Gorge, but is generally much less. Surface drainage is generally dendritic, with associated environmental problems related to flooding, soil erosion, and mass wasting (land slides). The major land cover is mature forestland (generally greater than 80 years of age) which resulted from forest regeneration after extensive clear-cutting during the early 20th century with patchy younger forests, which resulted from agricultural land abandonment during much of the mid-part of the century. Most of this forest area is classified as diverse/mesophytic forest with additional areas of mountain hardwoods, mixed oaks, cove hardwoods and floodplain forests. The major watersheds of the region include: Tug Fork, the Lower and Upper Kanawha, the Lower and Upper Guyandotte, New, Gauley, Coal, Elk, Big Sandy, and Twelvepole Creek watersheds.

Since the time of European settlement during the 18th century, development has been focused primarily along major rivers and tributaries. Beginning in the mid 19th century, development became more and more dispersed and distributed throughout the entire region, resulting in one of the most rural populations of anywhere in the United States – even to this day. Major present-day communities in the region include: Charleston, South Charleston, Dunbar, Nitro, Beckley, Mt Hope, Welch, Logan, and Summersville. Numerous smaller towns and communities are scattered throughout the region, generally located on river and tributary floodplains. Present-day population densities range from fewer than 40 persons per square mile in portions of Boone, Lincoln, and Mingo Counties to between 1,500 and 3,500 persons per square mile in portions of Charleston and other communities in the Kanawha Valley. Land that was level enough for agriculture was generally cleared, especially in the stream valleys and on ridge tops. Most of this agricultural land has since been abandoned or converted to other land uses. Most slopes were logged repeatedly. However, the region is presently almost 88% forested.

Mining in the Region

The mountaintop mining study area is comprised of two major coal areas – the Allegheny – Kanawha and New River – Pocahontas areas. Within these areas the major coalfields include the Gauley – Greenbrier, New River, Pocahontas, Williamson, Logan, Kanawha, and Elkins coal fields. Beginning in 1817, the Kanawha coalfields were one of the leading coal producing and consuming areas in the country – surpassed only by Mercer County, Pennsylvania (Workman 1994). Nearly all of this early mining was deep or underground mining. By the Civil War, there were over forty companies operating in this region – Kanawha, Lincoln, Boone, and Clay Counties. The northern portion (Braxton and Webster Counties) of the region began to be developed after the Civil War, and extensive mine development began in the New River area beginning in the 1870's. It was the incremental development of the railroads that provided most of the impetus for coal mine development in these areas. Prior to World War II, the predominate method of coal removal in the study area was underground mining. Beginning in the 1940's, contour strip mining, which can be practiced on very steep terrain began to be utilized in the region. Contour surface mining consists of removing overburden material from above the coal seam or seams starting at the outcrop (where the coal seam daylights on the ground) and proceeding around the hillside. Prior to contemporary mining regulations, the overburden was generally cast down the hillside. Today regulations mandate that the overburden is initially stacked and then replaced with successive cuts, with the resulting reclamation approximating the original terrain of the land, though there are provisions for placing portions of the resulting overburden into constructed valley fills.

Mountaintop Mining. First demonstrated in 1967, early mountaintop mining was initially merely an extension of contour mining. Series of contour cuts were developed to encircle the mountain ridge proceeding toward the center of the mountain. The entire mountaintop might have been removed or the topmost portion of the mountain might have been left resulting in a partial "apple core" landform pattern where coal removal was not completed. Auger mining was often utilized to remove the coal that remained under the topmost portions of the mountain ridge. This method of mining had a number of disadvantages, including: increasing overburden depths to retrieve additional coal resulting in increasingly poor mine economics (discouraging coal removal at the ridge tops); a lack of sufficient room for backfilling of the mined areas resulting in numerous valley fills around the ridge; and the need for extensive erosion and sedimentation control systems because of the vast areas of land that were disturbed at the same time.

Most modern mountaintop mining generally involves some form of cross-ridge mining (Skelly and Loy 1983). With this form of mining, series of benches (active coal recovery areas) are aligned perpendicular to the long axis of the mountain ridge and mining advances along the ridgeline, usually from one end of the mountain to the other. This method has a number of important advantages over earlier forms of mountaintop mining. These advantages include: consistent economics over the life of the mine; backstack (backfill) space is provided in closer proximity to the active mining area resulting in concurrent mining and reclamation; and the need to numerous valley fills is reduced because of improved backstack potentials. In general terms, the following are

generally recognized attributes of mountaintop mining as it has been practiced in southern West Virginia:

- Mountaintop mining has allowed for the recovery of coal that would be difficult to recover with other mining methods;
- Extraction costs are reduced because of the simultaneous extraction of coal from multiple coal seams;
- Mountaintop mining is used to permit efficient handling of overburden with mountaintop mining regrading provisions allowing for some overburden disposal into hollows or valleys resulting in additional spoil storage space for effective mining to the lowest recoverable coal seam; and
- The technique has created large valley fills and significantly altered the topographic configuration of the original mountain terrain above the lowest mined coal seam (Resource Technologies Corporation 2000) throughout much of the 14 county mountaintop mining region of southern West Virginia.

Background – Land Use in the Mountaintop Mining Region of West Virginia

Existing Land Use / Land Cover.

Table 1 summarizes current land use / land cover in the study area. These results were derived from classification of recent Landsat satellite data (1994- 1995 initial dates and 2000-2001 update dates). The satellite data were classified, mosaiced and converted to a GIS (geographic information system) coverage for analysis and display. Figure 2 presents a map of current land use / land cover that was derived from that same classification effort. The land use / land cover classes that were utilized were selected to provide the greatest amount of meaningful detail about the area yet be efficiently obtainable using remote sensing.

These classification results confirm the forested / lightly developed character of the mountaintop mining region. Almost 88%, or slightly over four million acres were classified as mature forestland with the diverse mesophytic forest type being most prevalent at almost three million acres of area. All developed land uses (intensive urban, moderately intensive urban, light urban, populated areas, major roads, and infrastructure such as power lines) only accounted for 155,000 acres or roughly three percent of the area. Agricultural land uses were found on approximately a quarter of a million acres or five percent of the area. Other general land use / land cover categories include: shrub land and woodland areas with slightly over 63,000 acres; water / wetlands with 56,000 acres or one percent of the area; and barren land – mining being 74,000 acres or 1.5% of the study area. The barren land – mining category significantly underestimates the acreage in mining because it includes only areas that were essentially in bare or nearly bare soil at the time of image acquisition – so it does not include reclaimed areas. So subsequent mined area acreage estimates were developed using other methods.

Land Use Data and Methods. Landsat satellite data from two different time periods were utilized for this classification. Various date mid-1990's data that had been previously classified to identify the major forest / natural land types in the area provided the basis for this analysis. Leaf-off various date years 2000 / 2001 imagery were utilized to augment this classification with greater detail and a more up-to-date classification for the developed land use / land cover classes. Details concerning the natural land cover classes can be found in the WVU – NRAC, 2001 WVGAP Final Report. The developed land use classes that were utilized are described below.

- Intensive urban – areas where a majority of the land surface is impervious covered by buildings or surface paving – includes city and town centers.
- Moderately intensive urban – areas where approximately half of the land area is impervious – primarily includes town centers and areas adjacent to city centers.

Table 1. Current land use/land cover in the West Virginia mountaintop-mining region, WVU-NRAC classification.

Cover Type	Area (Acres)	Percent
Major power lines	16,191	0.33
Major roads	2,794	0.06
Populated areas	19,450	0.40
Light intensity urban	75,645	1.55
Moderate intensity urban	19,584	0.40
Intensive urban	21,330	0.44
All developed	*154,994*	*3.18*
Planted grassland	1,201	0.02
Conifer plantation	204	0.00
Row crop agriculture	3,127	0.06
Pasture/grassland	241,589	4.95
All agriculture	*246,120*	*5.04*
Shrubland	46,451	0.95
Woodland	16,880	0.35
All shrubland/woodland	*63,332*	*1.30*
Floodplain forest	31,367	0.64
Cove hardwood forest	414,186	8.49
Diverse/mesophytic hardwood forest	2,930,112	60.05
Hardwood/conifer forest	52,387	1.07
Oak dominant forest	391,735	8.03
Mountain hardwood forest	463,760	9.50
Mountain hardwood/conifer forest	1,022	0.02
Mountain conifer forest	81	0.00
All forest	*4,284,651*	*87.82*
Surface water	53,084	1.09
Forested wetland	1,185	0.02
Shrub wetland	1,303	0.03

Herbaceous wetland	968	0.02
All water/wetland	*56,540*	*1.16*
Barren land - mining, construction	73,499	1.51
All barren/other	*73,499*	*1.51*
TOTAL	4,879,135	100.00

- Light intensity urban – areas where less than half of the land area is impervious but impervious areas still cover a significant amount of the area – includes rural communities and small town centers.
- Populated areas – areas with mixed land cover that has significant amounts of development in checkerboard patterns with significant population densities – includes suburban and lightly populated residential areas.
- Major roads – includes primarily highways and interstate highways.
- Major power lines – includes primarily high voltage power lines.

The basic method that was utilized for satellite data classification was based on unsupervised cluster labeling (ISOCLUSS classification with cluster separation and aggregation) using over 10,000 aerial and ground sample points that had been previously classified as part of an earlier project. Unsupervised cluster labeling is a proven technique for developing regional land cover classifications from satellite data. It must be noted that there are certain limitations in this classification. It certainly underestimates areas in very small communities and other dispersed developed areas. This is due to many of these developed areas being under heavy forest cover or in agricultural areas, and were not detected, and as such were placed into other land use classes. Other methods were utilized in later analyses to better estimate the number of locations of populated places in the region.

The results of a second land use / land cover classification that was available are summarized in Table 2 and Figure 3. These results are from the National Land Cover Dataset (NLCD) that is available for West Virginia (USGS 2000). These results are close to the results that were achieved by the WVU – NRAC classification. However, the results from the WVU classification were focused on in this report because they were developed using classification and intensive accuracy assessment methods that were designed to specifically respond to local vegetative, development, and topographic conditions throughout the region. The NLCD dataset was developed using methods more suitable to wide-area regional assessment requirements.

Land Use / Land Cover Change

Table 3 presents general land use / land cover changes for the study area examining three different time periods – 1950, 1976, and current conditions. Four general land use / land cover classes were utilized because class aggregations were required to

make the data that were available for the different time periods comparable. These results indicate the following general patterns of land use change in the region:

- The acreage of developed area increased from 42,533 acres in 1950 to 154, 966 acres currently. This acreage probably does not include much of the dispersed developed that dominates the region.
- Agricultural acreages decreased from almost a million acres in 1950 to 188,000 acres in 1976 and increased from 1976 to current time to 246,000 acres. Much of this acreage is actually due to coalmine reclamation that converted areas from forestland to grassland / pasture.
- Forest areas increased from under four million acres in 1950 to almost 4.5 million acres in 1976 and then fell to under 4.3 million acres currently.

Table 2. Current land use/land cover in the West Virginia mountaintop-mining region, EPA MRLC/NLCD classification.

Cover Type	Area (Acres)	Percent
Low intensity developed	51,780	1.06
High intensity developed	9,885	0.20
All developed	*61,665*	*1.26*
Hay, pasture, grass	101,733	2.09
Row crops	52,213	1.07
Mixed pasture, low intensity agriculture	101,958	2.09
All agriculture	*255,904*	*5.25*
Conifer forest	111,027	2.28
Mixed forest	466,961	9.57
Deciduous forest	3,872,449	79.37
All forest	*4,450,436*	*91.22*
Palustrine forested wetland	1,133	0.02
Palustrine shrub/scrub wetland	1,236	0.03
Palustrine emergent wetland	1,221	0.03
Other palustrine wetland	3,027	0.06
Open water	44,341	0.91
All water/wetland	*50,957*	*1.04*
Barren - quarry and mining	52,146	1.07
Barren - transitional	7,769	0.16
All barren/other	*59,916*	*1.23*
TOTAL	4,878,878	100.00

Table 3. Summary Land Use Statistics for the West Virginia Mountaintop Mining Region.

Land Use	area (acres)			percentage		
	1950	1976	Present	1950	1976	Present
developed	42,533	135,566	154,966	0.9	2.8	3.2
agricultural/open	950,135	188,363	246,082	19.5	3.9	5.0
forest	3,873,619	4,450,580	4,284,141	79.4	91.2	87.8
disturbed (includes some mining)	3,015	85,598	73,502	0.5	1.8	1.5

Land Use Changes	area (acres)		
	1950-1976	1976-Present	1950-Present
developed	92,933	19,501	112,433
agricultural/open	-763,772	57,719	-706,503
forest	576,961	-166,439	412,522
disturbed	84,583	-12,096	72,488

- Current loss of forestland is due to patterns in mine reclamation converted land from forest to open – grassland / pasture and to new urban development in the region.
- Disturbed areas increased from just over 3,000 acres in 1950 (indicating low amounts of surface mining) to a high of 85,000 acres in 1976 and over 73,000 acres currently. Again this acreage does not reflect mined areas so much as it indicates areas mined areas that were unvegetated in those time periods.

Land Use / Land Cover Change Data and Methods. The data that were assembled for this assessment were obtained from a couple of different data sources. 1950 data were obtained from detailed paper maps that were compiled during a four-year land cover-mapping project that was completed by the U.S. Forest Service for West Virginia. These data were published in 1950. The data had been previously digitized on a 15minute quadrangle map basis by WVU – NRAC. A seamless dataset for the mountaintop mining study area was developed by mosaicing the individual maps and removing numerous map-to-map discrepancies that were observed. The 1976 data were the available were USGS GIRAS land use data that were digitized by USGS from 1976 vintage 1:48,000 scale aerial photography. A seamless data set of the 1976 date data set for the study area was developed by mosaicing the individual 1:100,000 quadrangle maps that form the base for this mapping and then removing map to map inconsistencies that were detected. The current land use data were again the results of the WVU – NRAC satellite data classification effort. These data were developed by mosaicing the data that were developed on a large watershed / ecological areas basis with potential applicability at 1:24,000 scales and larger.

Extent of Mining and Land Use / Land Cover

A separate estimation of the extent of mining as a separate land use / land cover class was developed because the land use classification that was developed by WVU or the classifications that were available from other sources are generally felt to significantly underestimate mined areas by placing reclaimed areas into other land use / land cover categories such as grassland / pasture and forest. Table 4 and Figure 4 present the results of this mapping compilation. This was an attempt to compile the best available data sources for the mined areas that were identified; cross reference the different data sources; and then check the compiled data using sources such as current aerial photography. Cross-referencing and checking were utilized to remove duplication and rectify discrepancies between the different data sets. It is recognized that differences in the data sets that were utilized (e.g. aerial photography vs. satellite data vs. field sketch mapping) potentially does reduce the utility and comparability of these data. However, a compilation of the best available data did seem to be the most efficient method for developing an extent of past mining assessment for the study area. This assessment potentially does, again, underestimate the area of past mining because the majority of the data sources that were utilized potentially did not capture mined areas that had little or no physical evidence that mining had taken place. This was generally due to reclamation or natural regeneration of forest cover over the mined areas.

Extent of Past Mining Methods and Results. Table 4 lists the major data sources that were tabulated. New photo-interpretation of color infrared aerial photography and SPOT panchromatic satellite data (fall 2000 dates) was completed to verify or rectify inconsistencies in the other data sources.

Results of this compilation indicated that over 244,000 acres or approximately 5% of the area contained evidence as having been disturbed by past or current mining. This indicates that mining related land uses are the second most prevalent land use / land cover in the region – after forestland. This total includes a number of different mine types – unreclaimed abandoned mines, unreclaimed mines with forfeited bonds, reclaimed mines (where the resulting post-reclamation land use allowed for identification and delineation), and active mines. Again it is probable that significant mined areas were undetected by the various data sources, as well as subsequent checking and verification. However, Figure 4 mapping results could be combined with Figure 2 to develop a more realistic indication of the importance of past and current in the land use / land cover of the region.

Current Mining – Land and Land Use

Current mining was examined focusing on permit data rather than physical evidence of past or current mining. Permits were utilized as an indicator of current mining activities because permits contain land in three different conditions – areas that have been mined and reclaimed awaiting bond release, areas that are actively being mined, and areas that potentially will be mined in the near future.

Current Mining Permits Methods and Results. Table 5 presents a number of different summary statistics for current mining in West Virginia and the mountaintop-mining region. These data were obtained from two different data sources:

- Surface and deep mine permit records from WVDEP that were available in digital form in various WVDEP databases.

- Digitized permit boundaries that are being digitized by WVU-NRAC under contract to WVDEP.

Table 4. Extent of Past Mining Disturbances in the West Virginia Mountaintop Mining Region

Total identified disturbed acreage (all mining disturbances) *	=	244,664 acres 5.01% of region

Data Sources:

1. Photointerpretation of 1997 West Virginia digital ortho quarter-quadrangles by WVU-NRAC.
2. Photo interpretation of 2000 SPOT panchromatic imagery by WVU – NRAC.
3. Automated classification of Landsat TM data for 1994, 1995, and 2000-year dates.
4. Landsat satellite data (year 2000) NDVI classification by Tennessee Valley Authority.
5. Photointerpretation of West Virginia digital ortho quarter-quadrangles by WVDEP – TAGIS.
6. West Virginia Abandoned Mined Land Inventory - WVDEP.
7. West Virginia DEP files – bond forfeiture sites.

* Estimate does not include areas that have been fully reclaimed or converted to a post-mining land use.

Table 5. Current Mining Permits – Summary Statistics for the West Virginia Mountaintop Mining Region.

1. Current permitted coal mine area in West Virginia	307,802 acres
2. Current permitted coal mine area in the mountaintop mining region of West Virginia	247,364 acres
3. Current permitted mountaintop-mining area in the mountaintop mining region of West Virginia**	65,354 acres
4. Average area for current mountaintop mining permits	585 acres
5. Average area of 20 largest current mountaintop permits	1728 acres

6. 100 largest area permits in West Virginia
   - 40 are mountaintop mining permits
   - 60 are deep mine and coal processing complexes (surface acreage only – underground mined acreage is not included.

** Figure includes currently permitted mountaintop mines that have active / inspected by WVDEP. Does not include new permits where mining has not been initiated.

These results indicate that almost three-quarters of the total coal mine permit area for West Virginia is in the fourteen mountaintop-mining region. Of the total permitted area in the region, over one quarter is in mountaintop mines – the remaining are contour mines, surface areas impacted by underground mines, and coal preparation and cleaning facilities that often contain very large coal waste disposal areas. The results also indicate that the average permitted mountain area is almost 600 acres and the average area for the twenty largest mountaintop mine permits is 1,728 acres. This pattern indicates a tiering pattern in the size of West Virginia mountaintop mines – with a number of mines in the 400 – 700 acre range and a relatively small number of very large mountaintop mines. For comparison purposes, in examining the 100 largest permit areas for West Virginia, it was found that 60 of these areas are actually deep mine and coal processing complexes and 40 are mountaintop mines.

Table 6 presents pre-mining land uses for the current mountaintop mining permit areas. Figure 9 presents a map of current mountaintop mining permits in the region.

These data were developed by overlaying 1976 and 1995 land use / land cover data (used as a pre-mining estimate) with the permit boundaries that were digitized by WVU-NRAC under contract to the WVDEP. These results show that the majority of the pre-mining permit areas are forested (app. 92%) and almost 5% were previously disturbed mined areas. The remaining areas include small amounts of shrubland, woodland, power lines and light intensity urban development (small populated areas). Table 7 shows the proposed post-mining land uses for the same permit areas. These data were obtained from WVDEP digital permit data files. This table indicates a minor shift in land use between the pre-mining and proposed post-mining land use conditions. Almost 50% of the proposed post mining land uses include forms of open land including hay / pasture, animal grazing, and some additional open-land in combined / multiple use areas (generally a combination of forest and open land areas). Most of the remaining area is proposed for various forestry related land uses (over 50%), with less than 2% of the total area proposed for new residential / housing and public service / public use (infrastructure development) land uses.

Table 6. Pre-mining Land Uses in Current Mountaintop Mining Permit Areas.

Land Use	%
Shrubland	0.97
Woodland	0.32
Major Power Lines	0.32
Light Intensity Urban	0.32
Pasture / Grassland	0.97
Barren Land - mining, construction	4.85
Cove Hardwood Forest	16.50
Diverse / Mesophytic Hardwood Forest	60.19
Hardwood / Conifer Forest	0.97
Oak Dominant Forest	9.39
Mountain Hardwood Forest	5.18
Total Acreage	65,354 acres

Table 7. Proposed Post-mining Land Uses in Current Mountaintop Mining Permit Areas**

Land Use	Percentage of permitted area
Forest / wildlife	36%
Commercial woodland	5%
Woodland	27%
Hay / pasture	20%
Animal grazing / pasture	4%
Combined (multiple land uses)	7%
Residential / housing	<1%
Public Service / public use	<1%

** Land use categories utilized by WVDEP in describing proposed post-mining land uses in mining permits.

Land Use and Development in the Mountaintop Mining Region

Mining Regulations and Post-mining Land Use

The Federal Surface Mining Control and Reclamation Act (SMCRA) is the source of the rules and regulations that must be followed when planning and implementing post-mining land uses on mountaintop mined lands. In general terms, SMCRA provisions are designed to minimize the environmental and health and safety effects of surface coal mining. One of the most important provisions of SMCRA, in terms of how steep slope mining is practiced through most of southern West Virginia, relate to the general requirement that disturbed lands be reclaimed to approximate original contour (AOC) (OSMRE 1999). However, when Congress passed SMCRA, it did allow for exemptions to AOC in situations where excess post mining spoil may be present or where beneficial post mining land uses would compensate for the potential adverse impacts of not returning the land to AOC, such the number and size of valley fills that are required for disposal of the excess spoil that is generated when AOC is not desirable.

AOC requirements are addressed in the regulations, in terms of methods and allowances for disposal of excess spoil material, in three general areas:

- Excess spoil disposal requirements for steep slope contour mines in conditions where spoil material swell results in post mining material volumes exceeding the volumes needed for return the post mining topography to approximate original contour. There are detailed procedures for determining the amounts of material that must be backfilled to achieve AOC and how much material can be placed into valley fills. Highly detailed specifications for the construction of such fills are also included.
- Excess spoil disposal requirements for steep slope mountaintop mines where spoil material swell results in material volumes that exceed the volumes needed for return to AOC. Again, there are very specific detailed procedures for determining the amounts of backfill (backstacking on mountaintop mines) material vs. the amount of material that can be placed into valley fills.
- Excess spoil disposal requirements for steep slope mountaintop mines where alternatives to AOC might be warranted when beneficial post mining land uses would result from the proposed mining and reclamation. The legislative intent of these provisions relate to certain post mining land uses compensating for the negative impacts of not returning the land to an AOC condition. For example, the regulations could be used for creating relatively level, stable, flood hazard free land capable of supporting development types that require such land for successful development – residential, industrial, agricultural, or public facility development. It is the excess spoil material requirements that relate to post mining land use planning and development that most critically relate to mountaintop mine post mining land use planning and implementation.

In passing SMCRA, Congress did foresee that the land use provisions could be utilized merely as a method for circumventing AOC requirements and not as a device for improved land use and economic development in the region, as the Act intended. Congress, therefore, provided specific guidance for using the land use exceptions for potentially ensuring that economic or public benefits actually result from the planned reclamation post mining land uses. Three general sets of requirements were provided:

1. The post mining land use must provide for equal or better economic or public use of the land compared to the pre-mining land use.
2. The specific land use types that actually would require modifications to AOC to be successfully implemented – industry, commercial, agriculture, residential, and public facility, including public recreation development. Other potential land uses did not qualify for consideration for AOC exemption, at least based on land use.
3. Specific criteria for plan development by the mining companies and plan review by the relevant regulatory agencies. Included are the requirements that:
    a. The proposed land use is compatible with adjacent land uses;
    b. It is an attainable land use according to market, need, and other socio-economic data;
    c. The required public and / or private investment is present;
    d. Public agency support / cooperation is evidenced for all land uses requiring some form of public involvement;

e. The required mining / reclamation plan that is required in mine permitting and monitoring procedures specifically considers the planned post mining land use; and
f. The reclamation / land use plan be developed by professionals using appropriate professional standards.

The OSMRE codified these requirements through the regulations that have been developed and revised over time (since app. 1978) to implement these provisions from SMCRA. For a review of these regulatory provisions see OSMRE 1999. The regulations have been modified and adjusted over time always considering the initial intent of the AOC and land use provisions of SMRCA – the exemptions from AOC due to the planned post mining land use are permitted only where beneficial post mining land uses actually result and compensate for not returning the land to AOC. Two guiding principles have played significant roles in how the relevant regulatory provisions have been developed and interpreted by OSMRE.

1. A post mining land / AOC variance will not be approved when the proposed land use can be achieved without waiving the AOC requirement. The only exceptions are when significant public benefits or economic benefits will result from the development. Over the years this provision has been interpreted very differently when considering land uses such as agriculture, pastureland, and wildlife habitat.
2. In cases where the AOC exemption is required for implementing the proposed post mining land use, the post mining land use must always offer a net benefit to the public or to the economy of the locale or region. Again, there have been different interpretations of this provision over time. At a minimum, it appears that currently the proposed post mining land use can be similar to the pre-mining land use only if the reclamation results in site improvements that enhance to post mining land use.

It appears that current interpretations of these provisions can allow for AOC exemptions for the following land uses:

- Forestry – managed forest lands are generally allowed.
- Agriculture – allowed though low intensity agricultural uses such as grazing and pastureland are not encouraged.
- Fish and wildlife habitat – generally not allowed except in cases when serving as an adjunct to other land uses such as recreation.
- Public facilities – are generally allowed.
- Commercial – generally allowed.
- Industrial – generally allowed.
- Residential – generally allowed.

West Virginia implements these provisions with the West Virginia Surface Coal Mining Act and the regulations that have been promulgated to support that Act. These provisions generally mirror the provisions of the Federal Act and regulations. However, until recently there were a couple of key areas in which West Virginia's implementation of the regulations somewhat diverged from Federal interpretations on how the regulations should be implemented. From the early 1980's until the mid- 1990's, West Virginia appeared to be more willing to accept less intense land uses such as fish and wildlife habitat, pasture land, and grazing as post mining land uses suitable for AOC variances for mountaintop mining. As such, mountaintop mining AOC variances appeared to be provided somewhat matter-of-factly, rather than after careful consideration of the above AOC / land use provisions. This has changed over the last couple of years, and West Virginia is now rigorously subjecting post mining land use plans to the above evaluation criteria.

In addition, until recently, review of proposed post mining land use plans was primarily a part of the permit review processes that are utilized by the West Virginia Division of Environmental Protection. As such, in many instances proposed post mining land use reviews often only anecdotally considered the requirements related to land use compatibility and need, land use feasibility and economics, and economic and public benefits that can realized by the locale and region from implementation of the potential land use. To compensate for this acknowledged shortfall in post mining land use review, the West Virginia Legislature enacted Senate Bill 681 in 1999. This bill established the West Virginia Office of Coalfield Community Development (OCCD) within the West Virginia Development Office. The bill also established the requirement that coal operators (with operations above a prescribed minimum annual production) prepare Community Impact Statements, that detail their operations describing the location, extent, duration and impacts of the mines on the land use and economics of the surrounding area. The OCCD then prepares Coalfield Community Development Statements for the mines and the potentially impacted communities. These statements include locale specific and regional land use and infrastructure development strategies, so that the land use and economic impacts of the mining and subsequent reclamation can be incorporated into regional community and economic development efforts. An initial Coalfield Community Development Statement is under preparation and a number of affected coal operations have prepared and submitted their initial Community Impact Statements.

Land Use Planning in the Mountaintop Mining Region

In West Virginia, land use planning can be performed by municipalities, counties, and consortiums such as city / county combinations (any incorporated public entity has the power to plan). State and Federal agencies also conduct land use planning efforts in the state. However, these efforts generally only involve lands that the agencies control or manage, or only indirectly impact land use through activities such as road and infrastructure construction. As in other states, enabling legislation provides the basis for this local planning activity. In typical fashion, city and regional plans are constructed to implement the community's land use and development goals and visions for the future.

These plans can also provide the basis for plan implementation using devices such as zoning and subdivision regulations.

Historically, there has not been a strong consensus for planning or plan implementation throughout most of West Virginia. This is certainly true for the mountaintop-mining region. Table 8 summarizes plan and plan implementation activities for the mountaintop-mining region.

Table 8. Extent of Land Use Planning in the West Virginia Mountaintop Mining Region

County	Planning	Land Use Controls	Municipalities with Planning
Boone	no	no	Madison
Braxton	no	no	none
Clay	no	no	none
Fayette	yes	yes	Fayetteville, Oak Hill
Kanawha	yes	yes	Charleston, S. Charleston, Nitro, Montgomery, St. Albans, Dunbar
Lincoln	yes (limited)	no	Hamlin, West Hamlin
Logan	yes (limited)	no	none
McDowell	no	no	none
Mingo	no	no	Williamson
Nicholas	no	no	Summersville, Richwood
Raleigh	yes	yes	Sophie, Beckley
Wayne	no	no	Seredo
Webster	no	no	Webster Springs
Wyoming	no	no	Mullens, Oceana

This table indicates that there is a consensus for local planning in the three more heavily developed counties in the region – Fayette, Kanawha, and Raleigh Counties, but not in a majority of the region. However, there are various levels and forms of planning and plan implementation in a number of cities and municipalities in the region.

Because Federal and State governments control mining and reclamation (including post-mining land use planning), local communities (even those with planning) do not really have any direct control over post-mining land use planning and reclamation. However, post-mining land use compatibility with community zoning or subdivision ordinances is be required or at least considered during permit review. Local plan and ordinances may also be considered during WVDEP's review of the mining permit and proposed post-mining land use plans.

Local communities cannot develop or implement plans or ordinances that conflict with Federal and state activities related to post-mining land use review and control. However, though it has not been done on a widespread basis, local communities can use their planning and plan implementation to potentially limit mining in certain locations (such as special-use zones). Inclusion of mining related concerns in local communities planning or plan implementation ordinances, at least may require that some form of coordination or cooperation be required in the development of post-mining land use plans.

Regional Patterns and Trends in Land Use and Development

Land Use Development Opportunities in the Region. An analysis of region-wide land development potentials, limitations, and demands was completed to develop a broader context in which to assess land use needs, potentials, and demands for mountaintop mining sites for supporting various forms of development. This larger context is necessary for assessing the roles that mountaintop mine post-mining land use has, is, and can assume in determining regional land use development patterns. This larger context is important for addressing a number of important land use / development issues. For example:

- Conventional assessments indicate that much of the development that has occurred in the region has occurred on land that is often unsuitable for development (such as on floodplains and on unstable difficult to develop steep slopes);
- Reclaimed mountaintop mining sites have been and can continue to be a source of land that is more developable than adjacent un-mined areas; and
- Reclaimed mountaintop mine sites are often situated to be of limited development value because of poor transportation and infrastructure access even when the resulting land has high physical development potentials.

The first aspect of establishing this context was development and application of a regional land development potentials analysis analysis that considered mined and non-mined areas throughout the entire region. To accomplish this, a development / growth model was selected and adapted for use in the study area. Such growth models are often utilized to explain current development patterns and predict or determine the potential patterns and impacts of future development. A review of potentially relevant growth models revealed that a model referred to as the Clarke Urban Growth Model (CUGM) has been utilized in range of urban, suburbanizing, and rural settings – making it suitable for application in the Mountaintop Mining Study Area. The model has been used by a variety of agencies and organizations to examine land use development and potential development patterns in varying landscape conditions – coastal California, eastern Pennsylvania, South Dakota, Michigan, and South Carolina (USGS 2001). The model has also been adapted for use in areas undergoing rapid growth, as well as areas undergoing minimal or no measurable growth. Rather than determining or predicting future growth

rates, the model examines potential development and landscape patterns independent of potential growth rates or trends instead relying physical and socio-economic landscape attributes.

Regional Development Potentials Methods and Results. Models such as Clarke Model assume that growth patterns are determined by a combination of factors that encourage and factors that inhibit potential new development. The model is landscape based and does not consider socio-economic factors such as ownership parcel size, presence of willing landowners, zoning, and other governmental / regulatory factors that also can determine development pattern.

As implemented for this project, the model required development of a number of spatial data sets that represent the major development encouraging and inhibiting factors that have been identified for use in this study. Table 9 summarizes the parameters that were selected for inclusion in this analysis and Table 10 summarizes the results of the analysis placing the resulting development potentials values into five levels ranging from highest development potentials to highly restricted development potentials. Figure 5 presents the results of this analysis as a map.

The parameters that are included were selected because they appear to be the significant determinants of current development patterns as well as future development potentials. This analysis is not development specific but rather addresses any development opportunity that might require some level of investment or ongoing maintenance or management. This can range from relatively un-intense development such as managed forest or timberland to more intensive land uses such as housing or public infrastructure development.

Data Development.

- Opportunities for development
    - Proximity to paved roads – measured using proximity analysis for a GIS coverage of major paved roads in the region. High, medium, and poor proximity levels were utilized based on distance.
    - Proximity to infrastructure – measured using a GIS coverage of power lines and other major utilities. High, medium, and poor proximity levels. Does not include site-specific data such as proximity to local sewer and water service.
    - Proximity to existing development. Existing development is nearly always a source for new development. High, medium, and low levels were utilized using the Existing Development GIS coverage that was derived from the regional Land use / Land cover map.

- Constraints to development
    - Steep and unstable slopes – a 30% cutoff was arbitrarily established with slopes > 30% classified as steep and slopes < 30% classified as more developable. USGS digital elevation models (DEM's) were utilized for

this classification. A mosaiced 30-meter DEM was developed for the study area.

- Poor / unstable soils – NRCS STATSGO data were used to identify areas with high amounts of unusable / unstable soils. A 50% or greater cover of poor soils cutoff was utilized.
- High flood potentials – USGS DEM data were utilized to map areas with high flood potentials using a method developed by WVU-NRAC for mapping potential floodplains based on terrain. Flood potential areas were mapped for all major perennial streams using a stream coverage that was developed from existing USGS data and mosaiced for the entire study area.
- Proximity to mining related problems – proximity to abandoned mine health and safety and environmental problems was measured using distance from identified problems from the WV AML Inventory.

Table 9. Development Potentials Analysis Parameters

Opportunities for Development Parameters

1. Proximity to paved roads / accessibility
2. Proximity to utilities and infrastructure / accessibility
3. Proximity to existing development

Constraints to Development Parameters

1. Steep and unstable slopes >30%
2. Poor / unstable soils
3. High flood potentials
4. Proximity to mining related environmental problems and hazards
5. Proximity to other environmental problems and hazards
6. Land ownership that prevents / limits development opportunities

Table 10. Development Potentials Based on Proximity to Infrastructure, Anticipated Costs and Legal Restrictions in the West Virginia Mountaintop Mining Region.

Development Potential	Area (acres)	Percent of Region
Highest	1,357,703	27.8
Moderate	1,005,914	20.6

Limited	760,600	15.6
Severely limited	537,519	11.0
Highly restricted	1,169,903	24.0
Surface water	46,626	1.0

- Proximity to other health and safety and environmental problems – CERCLIS, RCRA, TRIS, and other potential problem sites were mapped from existing USEPA data and distance to the sites measured.
- Land Ownership – public land ownership patterns that essentially take land out of consideration for future development were mapped and identified as significant development constraints.

The data were combined through map overlay using a non-weighted overlay scheme. This approach was judged to be the simplest and most unbiased. The raw results included a numeric range in which the absolute numeric values really did not have any intrinsic meaning or significance. The resulting numeric range was divided into five equal levels according the numeric values and not the percentage of area in each class to determine area percentages of the region in each of the five development potentials classes. The results indicate that over 1.3 million acres or 28% of the land in the region were placed into the highest category that was judged to be land with some opportunity for development – though some development restrictions might be present (e.g. unstable soils). An additional 20% of the region was placed into a moderate development potentials category indicating development potential with potentially significant development restrictions (e.g. flood potentials). The remaining three classes – limited, severely limited, and highly restricted, represent areas where development restrictions generally far outweigh the development opportunities that are present.

These results indicate that though much of the undeveloped land in the region has limited development potentials, there is a significant supply of undeveloped developable land – though moderate development restrictions may need to be addressed in developing a majority of these areas (e.g. flood protection or special methods for steep slope conditions). Almost 50% of the region has limited development potentials due to the presence of what are often multiple severe development restrictions.

Regional Development Restrictions. Results from the previous analysis represented a balancing of development opportunities and development constraints. This analysis was completed to isolate only the factors that present severe limitations or constraints for development in the region – not balancing these factors with other positive development factors. This analysis better represents actual difficulties that may be encountered when developing areas in the region. The factors in this analysis were slightly modified from the factors included in the previous analysis. This analysis did not exclude publicly owned or managed areas so that those areas might be included in the analysis, and it did exclude currently developed areas from consideration for future development assuming

that current development precluded these areas from being considered for new development – though this is often not the case. Table 11 and Figure 6 present the results of this analysis.

Table 11. Development Restrictions Analysis

Area classified as having severe restrictions for development	1,918,141 acres	39.7% of the West Virginia Mountaintop Mining Region

Restrictions to Development Parameters

1. Steep and unstable slopes >30%
2. Poor / unstable soils
3. Flood potentials
4. Proximity to mining related environmental problems and hazards
5. Proximity to other environmental problems and hazards
6. Existing developed areas – unavailable for future development.

Again, a simple map overlay operation using the previously described data that had been developed for this project was utilized. Rather than place the results into a five level range, the results were presented as the presence of severe restrictions for development vs. presence of less severe restrictions for development. The area that was classified as having severe restrictions for development was isolated according to the following criteria:

- Presence of steep or unstable slopes - > 30% slopes plus soils with high potentials for slope failure and slides, or
- High flood potential areas, or
- Close proximity to mining and other health and safety and environmental problems - < .10 mile proximity, or .25 mile proximity in combination with any other factors, or
- Existing development.

The results of this analysis indicate that almost 40% of the region has severe restrictions for new development. The remaining 60% may have significant development restrictions that were judged to be not as severe as the parameters identified as severe.

County Patterns in Development Restrictions and Potentials. Table 12 summarizes regional development potentials on a county basis. These results indicate that the supply of both high development potential and highly restrictive potential land varies significantly throughout the study area on a county basis. For example, Nicholas, Raleigh, and Wayne Counties have significantly more land in the high and moderate

Table 12. Development potentials analysis by county (in acres).

County	High Potential	Moderate Potential	Limited Potential	Severly Limited Potential	Highly Restrictive Potential
Boone	44,299	55,984	63,249	55,145	102,391
Braxton	74,754	81,536	64,277	42,014	61,873
Clay	30,821	45,397	44,340	39,485	58,138
Fayette	174,105	92,786	48,609	27,735	79,149
Kanawha	229,339	130,626	82,192	50,943	82,511
Lincoln	109,141	55,432	29,939	20,769	62,724
Logan	39,418	50,618	55,243	49,313	94,713
McDowell	64,162	77,667	69,935	49,352	79,308
Mingo	45,250	55,066	55,986	42,306	70,985
Nicholas	128,637	91,971	57,672	37,402	97,416
Raleigh	177,968	74,056	42,818	24,710	66,417
Wayne	143,297	76,216	34,264	17,668	51,109
Webster	38,458	46,663	43,559	35,405	189,490
Wyoming	58,442	72,215	68,734	45,428	73,851
Totals	1,358,091	1,006,233	760,855	537,675	1,170,077

development potentials categories than in the severely limited and highly restricted classes. Mingo, Wyoming, Logan, and Boone Counties, on the other hand, have significantly more area in the severely limited and highly restricted classes than in the more favorable development potentials classes. As such, it is apparent that the impacts of developable and undevelopable land supplies are differentially felt throughout the mountaintop-mining region.

Table 13 presents county summaries for the development restrictions analysis that was summarized earlier. Again, it is apparent that a pattern of potential development restrictions varies in the region with counties such as Boone and Logan having significantly more of their area with severe physical limitations for new development.

Table 13. Development restrictions in the mountaintop mining region by county.

	Area (acres)	
County	**Potentially Limited**	**Severe Physical Limitations**
Boone	137,743	184,089
Braxton	258,770	71,465
Clay	161,833	58,038
Fayette	287,718	139,782
Kanawha	349,235	233,066
Lincoln	212,742	67,893
Logan	91,169	200,228
McDowell	146,587	195,001
Mingo	92,617	178,150
Nicholas	310,629	107,733
Raleigh	251,116	138,237
Wayne	261,469	65,903
Webster	234,469	121,165
Wyoming	163,573	157,391
TOTAL	2,959,670	1,918,141

Development Potentials and Restrictions and Flood Hazard Potentials. The impact of floodplains in providing land that would otherwise be developable (e.g. low slopes, proximity to infrastructure, developable soils, etc.) was examined. Table 14 summarizes the development potentials for floodplains in the study area. Floodplains were delineated using topographic data (landforms, slope, stream proximity, etc.) for all perennial streams in the study area. Approximately 434,000 acres were identified as being floodplain / riparian areas with potential flood hazard potentials. Table 14 indicates that except for potential flood hazards, that these floodplain / riparian areas include a great deal of land that is otherwise suitable for development. These are many of the areas that have been historically where development in the region has occurred.

Table 14. Development potentials in floodplains/ riparian areas in the mountaintop mining region.

Development Potential	**Riparian Area (Acres)**
High	197,185
Moderate	63,391
Limited	40,447
Severely limited	26,272
Highly restricted	67,579
Water	39,746

Table 15 summarizes development restrictions for the same floodplain / riparian area. If flood hazard potential is identified a critical development limiter then the entire 434,000 acre area should be regarded as unsuited for development. However, much of the existing highways, utility and development infrastructure is actually present in these areas.

Table 15. Development restrictions in floodplain / riparian areas in the Mountaintop mining region.

Development Restrictions	Riparian Area (Acres)
Potentially less severe restrictions	263,193
Severe physical restrictions	170,754

Mining and Development Potentials and Restrictions. Mine permit areas were combined with the development potentials and restrictions analyses that are summarized above to examine mine sites relative to the landscape in general. Simple map overlays of mine permit areas and Figure 5 and 6 results were utilized to complete this analysis. The results of this analysis are presented in Table 16. The first part of the table shows that

Table 16. Development Potentials and Restrictions Associated With Existing Permit Areas in the West Virginia Mountaintop Mining Region.

Development Potential	% of Area
Highest	23.17
Moderate	20.71
Limited	18.14
Severely Limited	14.89
Highly Restrictive	22.89
Surface Water	0.21
Restrictions for Development	**% of Area**
Potentially Less Severe	40.53
Severe Physical Restrictions	59.47

nearly 25% of all mining permits occur in areas with the highest development potential while 40% occur in areas with severely limited or highly restricted development potentials. Perhaps more significant is the bottom of the table, which indicates that almost 60% of all mining permits are in areas with severe physical restrictions for most types of development. As such, in many of these areas, the post-mining reclamation conditions that may result after mining can serve to improve the development potentials or reduce

the severity of the development restrictions in these areas by reducing slopes, improving surface drainage, or improving soil and slope stability conditions.

Development Potentials and Restrictions, Mining, and Present Development Patterns.

The current land use and land cover map that was developed for the study area potentially under-represents the potential exposure of many residents of the mountaintop mining region to both restricted (and potentially unsafe) development conditions and to past and current mining. This is due to the highly dispersed pattern of residential development that occurs through most of the region. This results in many small residential areas being classified as other land uses (e.g. forest land) when using data sources such as satellite data for the land use / land cover classification. To compensate for this, an additional assessment of residential patterns in the region was completed using mapping of populated places rather than land use areas.

For this analysis, populated places are defined as any places in which it appears that there are two or more inhabited structures. This approach should better capture the dispersed development patterns of the region by considering the unincorporated small mountain and valley communities that dominate the region along with the larger municipalities, towns and cities.

Populated Places Mapping and Analysis.

Populated places were initially identified and mapped using an available USGS data set that mapped populated places using the above definitions. This data set was combined with another data set of known cities, towns, and municipalities. These data were also then cross-referenced with the urban and other developed areas that were identified as part of the land use / land cover mapping effort. The resulting mapping was verified using comparison with recent aerial photography to document the present-day existence of these small communities and residential areas. When no trace of an area could be observed it was eliminated from the database. The resulting database also contains a category called historic places – older communities for which current-day habitation could not be verified using aerial photography or other maps such as county highway maps or the West Virginia Gazetteer. These areas are included separately. The result of this data collection was a more complete view of residential development patterns in the region. This pattern is presented in Figure 7.

Populated Places and Development Potentials and Restrictions

The results of a comparison of populated places and development potentials and restrictions are presented in Table 17. Results in the top portion of the table indicate that the majority of existing small communities and residential areas do occur in areas with high and moderate development potential and only a small fraction of areas occur in areas with severely limited or highly restricted development potentials. This logically follows because the development potentials criteria weigh factors such as transportation and infrastructure accessibility – which intrinsically are attributes of most developed areas. More revealing is the bottom portion of the table, which indicates that when considering

development restrictions only, almost 60% of these areas are in areas with severe physical restrictions for development primarily including steep unstable slopes and areas with severe flooding potentials.

Table 17. Development Potentials and Restrictions Associated with Populated Places in the Mountaintop Mining Region of West Virginia.

Development Potential	Populated Places					
	Current	Historic	Current	%	Historic	%
Highest	1077	29	73		1.5	
Moderate	108	16	8		<1	
Limited	75	7	5		<1	
Severely limited	37	14	3		<1	
Highly restricted	97	31	7		1.5	

Development Restrictions	Populated Places			
	Current		Historic	
	Number	%	Number	%
Severe physical restrictions	876	57.6	36	2
Potentially less severe Restrictions	548	35.7	71	4.7

Populated Places and Proximity to Mining

Populated places were evaluated in terms of proximity to mining for past mining, mountaintop mining permits, and all mining permits (Table 18.). This proximity analysis could be utilized as surrogate for assessing the impacts of mining on residential areas and small communities in the region. The results show that 99% of the populated places in the region are within two miles of one or more past mining features and almost 88% percent are within ½ mile of one or more mining features. Past mining proximity was determined by map overlay of mining features (Figure 4) and populated places (Figure 7). This result clearly indicates the pervasive importance of past mining in the lives of residents in the region, due and the close proximity of past mining features and many of these small communities.

Mountaintop mining permits present a very different pattern with only 18% of the identified populated areas occurring within two miles of one or more permits and under 5% occurring within one half mile. All mining permits present a different pattern with 55% of residential places within two miles of a current mining permit and less than 20% within one half mile of a current mining permit. This pattern clearly illustrates the separation of current mountaintop mining permits and most residential areas. This is due to mountaintop mining permits generally occurring on large unbroken ridge tops, where there is minimal or no existing residential development. Mining permits in general can occur throughout the landscape because they include contour surface mines, as well as deep mines and coal cleaning and handling facilities that often are found adjacent to roads and railroads in the stream and river valleys.

Table 18. Proximity of Existing Populated Places to Mining in West Virginia Mountaintop Mining Region

Extent of Mining	Distance From Mining (mi)	Populated Places	
		Number	Percent
Past mining	0.5	1255	87.9
	1.0	1366	95.7
	2.0	1414	99.0
Mountaintop mining permits only	0.5	63	4.4
	1.0	136	9.5
	2.0	253	17.7
All mining permits	0.5	271	19.0
	1.0	481	33.7
	2.0	774	54.2

Analysis limited to existing populated places only (Not including historic).
Percentage refers to percentage of all existing populated places in the mountaintop region

Other Land Use Development Issues in the Region.

Public lands and public land demands. A variety of public agencies and organizations own or manage land throughout the region. These agencies extend from local municipal governments (app. 100+) to Federal and state agencies that control significant amounts of land. Table 19 summarizes land holdings for the major public land owner/ managers in the region. It does not include smaller municipal and county public lands including schools, parks, public buildings, and facilities such as fire houses and police stations. These areas tend to be relatively small and located within existing developed areas.

Table 19 indicates that there are almost 300,000 acres of public lands in the study area. The major land owner / management types include wildlife management areas (WVDNR), The U.S. Forest Service forest lands, U.S. Department of Interior national recreation areas, and state parks and forests. The state of West Virginia and West Virginia University are also minor landowners in the region.

Table 19. Public Lands Stewardship in the West Virginia Mountaintop Mining Region.

Owner	Area (ha)	Area (acres)
Private (inholding in public areas)	24,592	60,767
Recreational Lake	3,818	9,433
National Recreation Area – USD1	23,838	58,905
National Forest – USFS	34,774	85,926
National Forest Wilderness Area – USFS	1,399	3,457
State of WV	36	90
West Virginia University	216	533
WVDNR State Parks	8,836	21,833
WVDNR State Forests	10,292	25,431
Wildlife Management Areas – WVDNR	54,978	135,851

(Land stewardship within 14 county Mountaintop Removal study area)

Recreation. Public land needs and demands are very heavily tied to recreation development in the region. There are certainly localized demands for public lands for uses such as schools, community parks, and other public facility developments. However, the acreage requirements for most of this development are minimal, and will be linked to existing community locations in most cases. Table 20 presents a compilation of the major demands for public lands in the region that have been identified by various Federal and state agencies. This table shows significant differences between counties in the region in the need / demand for hunting and fishing, water recreation, and special needs recreation areas – facilities that generally require large areas.

Table 20. Demand / Need for Public Land in the Mountaintop Mining Region of West Virginia.

County	Hunting/Fishing*	Water Recreation*	Special Access /Needs* Recreation
Boone	medium	medium	low
Braxton	medium	medium	medium
Clay	medium	medium	low
Fayette	medium	medium	medium
Kanawha	high	high	medium
Lincoln	high	medium	high

Logan	high	medium	medium
McDowell	medium	medium	medium
Mingo	medium	medium	low
Nicolas	low	medium	low
Raleigh	medium	high	medium
Wayne	high	medium	high
Webster	low	low	low
Wyoming	medium	medium	medium

Region-wide High Priority Needs**

Hiking trails
Swimming facilities
Picnic areas
Bicycle routes
Playgrounds
Playgrounds / courts and sports fields
Community and neighborhood parks

---

*West Virginia Division of Natural Resources Capital Improvements Plan – 1998.
**West Virginia State Comprehensive Outdoor Recreation Plan – 1997.

Non-recreation Needs. The most critical major non-recreation needs include land for new public water service and sewer facilities. In the study region, the most pressing needs are in Wyoming, McDowell, Mingo and Lincoln Counties. Five of the fourteen counties have less than 40% of the residents serviced by public water and seven counties have less than 30% of residents served by public sewers. Additionally identified needs include additional land for new and replacement schools, public health facilities, and public service buildings.

Land Use and Development Needs / Priorities in the Region. Future land use development needs are difficult to estimate for the study region because it is anticipated that the majority of the region will continue to loose population or current population levels will remain static. Population projections (U.S. EPA 1998) for current conditions to 2010, estimate that only Raleigh County will have a significant demand for new land use development based on anticipated population growth. This demand is estimated to range between six and sixteen square kilometers of required new development for the ten-year time period. Kanawha County is also expected to require new land for urban

expansion. However, much of this area is actually due to shifting development patterns rather than new growth. Projections indicate between sixteen and thirty new square kilometers of new urban land uses will be potentially developed in Kanawha County between 2000 and 2010. The other counties in the study area will require insignificant acreages for the new development that is anticipated during the ten year 2000 to 2010 time period.

Land Use Planning and Decision Making for Specific Mine Sites

General Background. On most land, land use decision-making is at least in part, a response to one or both of the following questions:

1. What is the optimum or at least desirable land use(s) for a given site or parcel of land?
2. What sites might be identified that are optimal or suitable for particular land uses of interest in a given region or locale of concern? (Skelly and Loy 1981)

Asking the questions together about a particular site or sites is often the concern of public planning and development organizations. Asking the questions together allows such organizations to develop plans that may address land use development and land protection comprehensively – considering the potential utility of any parcel of land within a context of also considering a larger public good. This type of land use decision-making is generally undertaken in order to:

- Take stock of a region's resources and developable land for activities such as economic development planning;
- Establish a data base for making regional growth and land protection decisions including potential public investments; and
- Provide a defensible base for potential public involvement in growth guidance or development through planning or regulation.

Such land use decision-making is generally undertaken within the contexts of various public planning and economic development activities where overall regional economic development and environmental protection are the focus. Asking the same questions separately, land owners, managers, developers and even mining companies are often interested in determining suitable land uses for specific parcels of land rather than searching for parcels suitable for development of specific land uses. As such, organizations such as land development companies, economic development agencies, and other development interests are generally concerned with finding and implementing feasible land uses for specific parcels. The context for such land use decision-making is generally focused on identifying site-specific rather than regional development potentials.

In fact, throughout much of Appalachia, it is obvious that many times these questions are not asked, or if asked, are not correctly answered. This is evidenced in the large percentage of Appalachia's historic, as well as, recent development that has occurred in: areas where access and development amenities are poor; areas with potential

environmental hazard situations (e.g. floodplains); areas with steep slopes or unstable soils presenting slide prone conditions; and, in areas with potentially valuable environmental resources resulting in destruction or degradation to many potentially valuable regional landscape resources such as scenic areas, wildlife habitats, and rare landscapes such as wetlands.

There are three general land use planning principles, which if adhered to by public and private development interests alike, will improve opportunities for avoidance of the above conditions through the landscape in general, as well as, specifically for reclaimed mine sites. These principles are:

1. Development should be discouraged in areas with significant resource preservation or protection values;
2. Development should be discouraged in areas with significant natural or man-made hazards present that cannot be reasonably abated or corrected; and
3. Development should be encouraged in areas best suited for it given the range of physical, contextual, and location parameters that can determine the desirability of a given land use or land uses.

Methods for Land Use Decision Making. Land use decision making often involves various forms of land use suitability analysis or development suitability, which present general planning frameworks based on the concept of determining what parts of the landscape in a given area are most capable of supporting one or more proposed land uses. Such land uses can include housing, wildlife, agriculture, recreation, and intensive development such as industry. This involves identifying the relevant natural and developed landscape features are for a given land use and how they can be managed or utilized to support the proposed land use. Land use suitability methods can range from very complex / systematic approaches to approaches that may be more informal and even anecdotal. The landscape characteristics used to determine suitability are often derived from: physical factors such as soils, slope, geology, hydrology, and climate; social/economic factors such as on-site and adjacent land uses, legal restrictions, proximity to and availability of utilities and infrastructure, land ownership; and the presence of potential problems / hazards such as high noise areas, air pollution patterns, potential flood problems, and other natural and manmade hazards. Typically included secondary factors often include:

- Vegetation and wildlife resources
- Cultural resources – on-site and adjacent
- Visual / scenic amenities

Therefore, in general terms, land use suitability factors generally include:

- On-site physical factors such as topography and soils;
- Site context including accessibility, utilities, and adjacent land uses; and
- Avoidance of environmental problems that may prove costly to overcome;

General Land Use Selection Considerations for Coal Mined Lands. In examining the above, as well as the previously discussed post-mining regulatory provisions, it becomes apparent that mining companies, land owners, and the public (adjacent land owners, people in the locale and region, local and regional governments) may have very different sets of objectives when viewing the land use potentials for particular mine sites. For example, mine operators often may be most interested in the following:

- Efficiently satisfying post-mining land use regulatory requirements with the least amount of risk;
- Ensuring that satisfying other permit requirements (e.g. for soil protection and erosion control) are linked to post-mining land use development efforts for operational and economic efficiency;
- If the operator owns the surface rights to the land, the operator may also be interested in maximizing return on the investment associated with reclamation.

Landowners may be interested in considerations such as potential economic return or at least ensuring that the post mining land use reclamation does not reduce the value of the surface of the land after coal recovery and reclamation have been completed. Likewise, the previously discussed post-mining land use regulations were developed and implemented because the "public" may be interested in the following aspects of post-mining land use planning and development:

- Ensuring that post-mining land uses potentially minimize potential off-site damages and maximize public benefits; and
- Ensuring consideration of public land use and economic development priorities and needs by participating in the post-mining land use decisions that are made.

The same general approaches that have been developed for determining land use suitabilities for non-mined areas can and have been applied to post-mining reclamation land use planning for coal-mined areas throughout Appalachia. However, this can generally only be accomplished with the recognition that many of these mine sites may have characteristics that are somewhat unique to mined areas and are typically not encountered on most non-mined sites that are being planned for a given land use or land uses. Such conditions can include:

- Decreased soil stability due to expansive backfill areas;
- Decreased topsoil productivity due to disturbances encountered during mining, storage, and reclamation;
- Poor proximity to transportation and infrastructure systems due to many surface mines being located away from existing development; and
- Presence of adjacent mining related health and safety and environmental problems that may stem from other mining that was completed prior to implementation of modern reclamation standards.

A comprehensive review of methods and criteria for land use decision-making for coal mined lands in central Appalachia was completed for this project. These results are summarized in the following table. The references utilized for constructing the table are included in the bibliography of this report.

Table 21. Post-mining Land Use Mine Site Requirements / Needs (Summary of current literature and regional expert opinion)

General Requirements

Post-mining Land Use	Available water	Suitable Area	Non-severe Terrain / Slope
Agriculture (cropland)	1	3	1
Agriculture (pasture)	1	2	3
Forestland / fish and wildlife	2	3	3
Commercial woodland	2	3	3
Residential / housing	3	3	2
Industrial / commercial	2	2	1
Public facilities	3	2	2

	Suitable Soil	Proximity to Infrastructure/ Utilities	Overburden Stability
Agriculture (cropland)	1	3	2
Agriculture (pasture)	2	3	1
Forestland / fish and wildlife)	3	3	2
Commercial woodland	2	3	2
Residential / housing	3	2	1
Industrial / commercial	2	1	1
Public facilities	2	1	1

	Site Accessibility	Site shape / Configuration	Surrounding Land Use Compatibility
Agriculture (cropland)	3	1	3
Agriculture (pasture)	3	2	3
Forestland / fish and wildlife	3	3	2
Commercial woodland	3	2	3
Residential / housing	1	2	1

Industrial / commercial	1	1	2
Public facilities	1	1	1

1 = high degree of influence
2 = moderate degree of influence
3 = low degree of influence in most cases

There are also numerous specific requirements that have been identified that can relate to the feasibility of various more intensive land uses. Examples of such specific requirements follow.

- **Commercial forest land**
    i. Determine feasibility based on site size, location, and markets
    ii. Careful placement of overburden materials on the surface
    iii. Reducing compaction during regrading and revegetation
    iv. Using tree compatible ground covers during the early stages of reclamation revegetation

- **Industrial / commercial development**
    i. Determine feasibility based on site size, location and available infrastructure
    ii. Careful regrading to develop relatively flat surface configurations
    iii. Develop areas of suitable size and configuration
    iv. Careful / well planning spoil replacement
        1. Uniformity in materials replacement patterns
        2. Constructed internal drainage systems
        3. Prepared surface material replacement allowing for fine regrading, construction, and revegetation

- **Row crop agriculture**
    i. Determine feasibility based on site size, location, and markets
    ii. Careful placement of overburden materials
    iii. Regrading gently sloping terrain insuring suitable drainage, slopes, and accessibility for required agricultural machinery.
    iv. Careful / well planned spoil replacement at the surface
        1. Uniformity in materials replacement
        2. Augmented topsoil replacement and productivity improvement

Such detailed criteria can be developed to evaluate or plan any potential post-mining land use.

Reclaimed Mine Land Use Development Case Studies. Developing reclaimed mined sites for various land uses is not a recent concept. Though a majority of reclaimed mine sites in southern West Virginia have been reclaimed to pasture / grassland, wildlife

habitat, and forestry, there are examples of reclaimed and abandoned coal mine sites being reclaimed to more intensive land uses. Many of these sites include reclaimed mountaintop mining sites. For example, Green (1976) and Skelly and Loy (1981) list examples of developed land uses on reclaimed mines. Examples are included in the following table.

Table 22. Examples of developed post mining land uses from the study area.

Land Use	Location
Commercial / Institutional	
Airport	Williamson
Airport	Logan
High school and Vocational School	Welch
Athletic Complex	Welch
Consolidated High School	Coal City
High School	Raleigh County
Housing	
Planned Community	Ward
Residential Subdivision	Beckley
Residential Subdivision	Corrine
Residential Subdivision	Rush Creek
Residential Subdivision	Peach Creek
Recreation / Open Space	
Hunting club	Summersvillle
Agriculture	
Orchard	Buffalo
Orchard	Buffalo
Truck Farm	Ward

More recently, there are a number of examples of reclaimed mountaintop and contour mines that have been reclaimed to various developed land uses in the 14 county study region. Some of the more noteworthy examples of such developments include the following:

Economic Development

1. Mingo County Wood Products Industrial Park (wood processing industrial facility) – Hobet #7 / Arch Minerals Site.

2. Mountain Greeneries, LLC (plant nursery) – Mount Olive – Fayette County.

3. Mingo County Redevelopment Authority Industrial Park (industrial park) – Mingo County.

4. Mingo County Fish Hatchery (fish raising facility) – Pigeon Creek, Mingo County.

5. Ragland Truck Farm (farm products) – Ragland, Mingo County.

6. Columbia Wood Mill (timber processing facility), Craigsville, Nicholas County.

Institutional and Recreation Development

7. Mt. Olive Correctional Facility (prison) – Fayette County.

8. Southwestern Regional Jail (regional correctional facility) – Logan County.

9. McCoy Hatfield Trail – Boone, Lincoln, Logan, Mingo, Wayne and Wyoming Counties – extensive regional trail system involving numerous reclaimed mine sites.

10. Beckley Recreational Complex (sports field complex) Raleigh County.

11. Twisted Gun Golf Course – Gilbert, Mingo County.

Other Land Uses

12. Calvin, Nicholas County – high quality hay land, forage, and pasture land development.

13. McDowell County – Virginia Energy Company – agriculture, pasture, outdoor recreation, and home site development.

14. Yolyn, Logan County – mixed development including aquatic wildlife habitat, pasture and grassland, fruit trees.

15. Bluestone Mining Site – Wyoming County – commercial forestry.

Assessment of Potential Land Use Impacts of Future Mountaintop Mining in West Virginia

Resource Technologies Corporation (RTC 2000, 2001) recently completed a study that was designed to estimate the effects of various valley fill restrictions on the quantity of coal potentially available for mountaintop mining operations in West

Virginia. That study generated a number of potential future mountaintop mining scenarios based on the various levels of mining that can take place under different sets of environmental constraints that can potentially limit the use of mountaintop mining methods. These constraints mostly relate to changes in mining as available drainage basin areas become more restrictive for mining and valley fill construction. These limitations also relate to the pattern that as drainage basin limitations become more severe (for mining / backstacking spoil, and valley fill construction), the area available for mining and reclamation becomes more limited using mountaintop mining methods. The constraints reflect different interpretations of environmental parameters such as ephemeral, intermittent, and perennial stream definitions and typical headwater watershed areas for various types of streams. These scenarios were utilized to estimate the potential impacts of future mountaintop mining in the study region using the RTC study generated GIS maps of areas potentially available for future surface mining based on this set of scenarios reflecting the different levels of potential environmental constraints. These scenarios are summarized below:

1. Unconstrained mountaintop mining – all areas suitable for future mountaintop mining will be mined using mountaintop-mining methods.
2. Slight constraints – composite 250-acre drainage areas are available in each headwater watershed for mining and reclamation.
3. Moderate constraints – 150-acre areas are available in each watershed for mining and reclamation.
4. Severe constraints – 75-acre areas are available for mining and reclamation.
5. Most constrained – only 35 acre areas are available in each headwater watershed for mining and reclamation.

The detailed GIS based analysis procedures and databases were utilized to develop region-wide maps of the resulting mountaintop mining mineable areas and relate those areas to current land use and residential patterns. These maps and supporting statistics form the basis for the analyses that follow.

Impact on current land uses. Table 23 summarizes current land use / land cover in these potential future mountaintop mining areas. As would be anticipated, these breakdowns reflect the land use and land cover patterns that are present in the landscape types that are suitable for future mountaintop mining – high forested ridges and steep slopes. There are therefore, few expected impacts on land uses such as medium and high intensity development, wetlands, or agricultural lands because these land uses were either precluded from mountaintop mine development or occur in areas with no potential for mountaintop mining (e.g. in the stream and river valleys). Instead, the major impacts will be felt on various types of forest lands, areas already impacted by past mining, shrublands and woodlands, and to a lesser extent in lightly developed areas and pasture / grasslands. It is therefore, the conversion of mature forested land to other land use / land covers that is anticipated to be the major land use impact of mining under any of the future mining scenarios.

Table 23. Current Land Use in Potential Mountaintop Mining Areas from Future Mining Scenarios (in acres).

Land Cover / Land Use	Future Mining Scenarios		
	Unconstrained	Slight Constraints	Moderate Constraints
Developed			
Major power lines	595	595	552
Populated areas	161	161	133
Light intensity urban	1,250	1,250	1,016
Moderate intensity urban	262	262	247
Intensive urban	360	360	316
Agriculture			
Row crops	84	84	82
Conifer plantation	6	6	5
Pasture / grassland	3,592	3,597	3,167
Shrubland / woodland			
Shrubland	2,679	2,679	1,905
Woodland	302	302	250
Forested			
Floodplain forest	431	431	424
Cove hardwood forest	35,671	35,671	26,842
Diverse mesophytic forest	135,372	135,832	108,437
Hardwood / conifer forest	2,180	2,196	2,043
Oak forest	14,188	14,214	11,587
Mountain hardwoods	23,612	23,612	17,563
Mountain hardwoods / conifers	353	353	345
Mountain conifers	173	173	183
Water / wetlands			
Surface water	726	726	587
Forested wetland	64	64	61
Shrub wetland	73	73	48
Herbaceous wetland	163	163	66
Other			
Barren / disturbed land	5,825	5,825	4,627
Total	228,117	228,625	180,482

Table 23. (continued)

Land Use / Land Cover	Severe Constraints	Most Constrained
Developed		
Major power lines	280	129
Populated areas	90	26
Light intensity urban	216	576
Moderate intensity urban	197	55
Intensive urban	301	106
Agriculture		
Row crops	81	55
Conifer plantations	29	0
Pasture / grassland	2,488	2,016
Shrubland / woodland		
Shrubland	1,088	563
Woodland	88	41
Forested		
Floodplain forest	284	99
Cove hardwood forest	15,423	4,133
Diverse mesophytic forest	69,450	34,148
Hardwood / conifer forest	1,507	948
Oak forest	8,553	4,454
Mountain hardwood forest	11,160	6,724
Mountain hardwoods/ conifers	350	348
Mountain conifers	173	181
Water / wetlands		
Surface water	243	145
Forested wetland	24	34
Shrub wetland	56	54
Herbaceous wetland	60	44
Other		
Barren / disturbed land	2,699	1,162
Total	115,199	55,727

*Acreage totals do not represent all past and current mining – only areas that were barren for the 1994,1995, and 2000 satellite imagery. These totals underestimate total previously mined acreage in the potential mountaintop mining areas.
**Future mining scenarios were developed by other mountaintop mining economic impact background studies. Acreages represent the acreages available for future

mountaintop mining with increasing constraints on backstack spoil material placement and valley fill construction (see Resource Technologies Corp., 2000)
***Summation inconsistencies represent rounding errors in calculations.

Impact on existing small communities. Table 24 summarizes the relationships between these potential mining areas and existing populated places in the region. The potential future mining areas data were combined with the populated places data (Figure 7) to complete this analysis. Simple GIS data overlays were utilized to combine the data. These results do indicate a pattern of potentially close proximity between existing populated places (the rural population in the region) and many of the areas suitable for future mountaintop mining. Resulting proximity values range from over 500 populated

Table 24. Potential impacts of future mining scenarios on existing populated places (number of populated places).

Constraints	within mine area	½ mile or less	1 mile or less	2 miles or less
unconstrained	42	222	320	536
minor constraints	42	222	320	536
moderate constraints	35	205	306	524
severe constraints	23	146	248	476
most severe constraints	6	95	183	389

places which may be within two miles of potential mining for the unconstrained scenario to a low of six areas that could be directly impacts by mining with the most constrained scenario. These results do indicate a pattern of significantly differing impacts on existing populated areas with each of the future mining scenarios. In summary, these results indicate that:

- Significant numbers of rural residents may be impacted by future mountaintop mining in terms of the potential impacts that are felt due to close mine proximities (noise, roadway traffic and congestion, temporary land use incompatibility).
- Significant numbers of rural residents may be within two miles or less of potential future mountaintop mining.
- The various levels of constraints for potential future mining do strongly impact the proximity of rural residents to potential mining areas with the unconstrained

and slight constraints scenarios impacting almost double of number of populated areas than the most constrained scenario.

Summary of Potential Future Mountaintop Mining Land Use Impacts

It is anticipated that the potential land use related impacts of future mountaintop mining will be most strongly felt in three general areas:

- Loss and conversion of existing land use / land covers;
- Temporary and permanent impacts on small communities and dispersed residential areas in the region; and
- Provision of new land uses and land use opportunities.

Loss and conversion of existing land use / land covers.

1. Future mountaintop mining under all of the future mining scenarios will significantly reduce mature forestland acreages in southern West Virginia – at least for the near term. The estimated acreages of lost forestland range from over 200,000 acres for the unconstrained scenario to just over 50,000 acres for the most constrained mining scenario.

2. Re-disturbance of previously mined areas is the second-most likely land use conversion. Acreages range from over 6,000 acres for the unconstrained scenario to nearly 2,000 acres for the most constrained scenario. Reclamation and post-mining land use potentials of these previously mined areas will be greatly improved in nearly all cases because of the improvements that are required in remining previously mined areas.

3. Future mountaintop mining will permanently impact only minor acreages of light intensity development, infrastructure such as power lines, and agricultural and pasture lands.

Temporary and permanent impacts on small communities.

1. Future mountaintop mining may impact numerous existing small communities and other populated places due to close proximities between mining and the communities. Impacts will include noise, dust, added vehicular traffic, etc. Such impacts can be regarded as temporary land use incompatibility impacts.

2. Potential permanent impacts will likely include some resident population relocation due to close proximities of people and potential future mining. For example, 222 populated places are .5 miles or closer to potential future mining areas and nearly 100 are .5 miles or closer even under the most constrained mining scenario. These small communities would be likely impacted by any potential future mountaintop mining.

Provision of new land uses and land use opportunities.

1. Most potential future mountaintop mining areas will be reclaimed to various forest cover related land uses- e.g. intensive forest and woodland management, recreation, and wildlife management. It is likely that current reclamation requirements will cause greater post-mining forested acreages to be managed for intensive woodland development than at present due to AOC / land use provisions, often resulting improved site topography (for management) and accessibility with reclamation. This is due to the refocusing of the AOC / post mining reclamation provisions in West Virginia granting AOC variances only in improved / more developed land use conditions.

2. Agricultural land uses will likely account for the next greatest acreage of post-mining land uses – potentially emphasizing specialized crops, row crops, animal production, aquaculture, etc., to utilize potential AOC / land use exemptions.

3. Given current and foreseeable future land use demands, it is unlikely that any more than 2 to 3% of the future post-mining land uses will be developed land uses such as housing, commercial, industrial, or public facility development. However, significant acreages of land suitable for developed post-mining land uses will result from future mining under all of the mining scenarios.

4. Significant additional acreages of land with development opportunities and potentials greater than the potentials that are currently present will result from reclamation in the potential future mountaintop mining areas in all of the future mining scenarios. Much of the acreage available for future mountaintop mining is in areas with current severe development restrictions (over 55% of the future potential mountaintop mining acreage). Development restrictions will be reduced on the majority of the reclaimed sites with implementation of current reclamation standards and practices. Development limitations such as poor accessibility and infrastructure proximity will continue in nearly all of these areas.

5. Land use plans for current and future potential mountaintop mining sites will be developed and evaluated with greater emphasis on locale and regional land use and economic development needs and potentials. This is due to amended review procedures and changes in the mountaintop mining regulations in West Virginia. The requisite mine site land use and community impact studies will potentially result in improved integration of post-mining land use plans and regional economic and infrastructure development activities throughout the mountaintop-mining region.

6. Recent regulatory changes will continue to result in greater placement of spoil materials in backstack areas rather than in valley fills. This actually may reduce future land use opportunities on many mountaintop sites, when compared with previous mountaintop mining practices, which resulted in flatter land because greater amounts of spoil material, were placed in valley fills. However, the land use potentials of such sites will still be greater than with pre-mining conditions due to required site regrading, stabilization, and revegetation, as well as the presence of new roads and infrastructure features that may remain after mining.

Literature Cited

Bogner, Jean and Alan Perry. 1977. Integrated Mined-Area Reclamation and Land Use Planning. Energy and Mineral Resources, Argonne National Laboratory – Prepared for US Geological Survey.

Burley, Jon B (ed.). 2000. Environmental Design for Reclaiming Surface Mines. Mellen Press, Emsworth ME.

Candau, Jeannette. 2000. The Clarke Urban Growth Model. University of California. Santa Barbara. Unpublished manuscript.

Greene, Benjamin. 1976. Restoring Grossly Disturbed Land to Agricultural and Other Uses. Northern Branch of the American Society of Agronomy Annual Meeting, July. Morgantown, WV.

Grim, Elmore. 1974. Environmental Protection in Surface Mining of Coal. EPA, Washington, D.C.

Harbridge House, Inc. 1979. Postmining Alternative Land Use Evaluation Methodology. OSMRE – NTIS. Washington, D.C.

Kentucky Department for Surface Mining Reclamation and Enforcement. 2001. Post Mining Land Use. Unpublished url - /dsmremap13/post_miningland_use.htm.

Office of Surface Mining Reclamation and Enforcement. 1999. Post mining Land use. USDI OSMRE, Washington, DC. October. Unpublished report.

Office of Surface Mining Reclamation and Enforcement. 1998. Draft Report. An Evaluation of Approximate Original Contour and Postmining Land Use in West Virginia. November. Washington, DC.

Penn State University. 1998. Chapter 5 – Land Use Planning. Handbook of Mining and Reclamation. Pennsylvania State University. State College PA.

Penn State University. 1998. Chapter 14 – Revegetation. Handbook of Mining and Reclamation. Pennsylvania State University. State College PA.

Resource Technologies Corporation. 2000. Phase 1 – Mountaintop Mining Economic Background Study. Unpublished. September 13.

Resource Technologies Corporation. 2001. Unpublished data – statistical summaries and maps for areas suitable for future mountaintop mining under various future mining scenarios. February.

Skelly and Loy. 1981. A Land Use Decision Methodology for Mined Lands in Appalachia. Appalachian Regional Commission. Washington, D.C.

Skelly and Loy. 1984. Environmental Assessment: Head-of-hollow Fill and Mountaintop Removal Mining – Final Report. USEPA, Washington, D.C.

Skelly and Loy. 1983. Demonstration of Cross-ridge Mountaintop Mining. USDI Bureau of Mines, Washington, D.C.

USDA Forest Service 1996. Ecological Subregions of the United States. USDA Forest Service, Washington, D.C.

USGS. 2000. National Land Cover Dataset for West Virginia – version 3. (Digital GIS data). USGS Sioux Falls, SD.

West Virginia Development Office. 1993. West Virginia State Comprehensive Outdoor Recreation Plan. Charleston, WV.

Virginia Cooperative Extension Service. 1996. Commercial Forestry as a Post-mining Land Use. Powell River Project Series. Virginia Tech, Blacksburg, VA

Virginia Cooperative Extension Service. 1997. Stabilizing Reclaimed Mines to Support Buildings and Development. Powell River Project Series. Virginia Tech, Blacksburg, VA.

West Virginia Development Office. 1997. West Virginia State Economic Development Plan. Charleston, WV.

West Virginia Development Office. 2000. EDA Program Narrative – Office of Coalfield Development (unpublished). Charleston, WV.

West Virginia Division of Environmental Protection. 2001. Unpublished mining permit data, digital map data, and permit summary statistics. WVDEP, Charleston WV.

West Virginia Division of Environmental Protection. 2000. AOC and Excess Spoil Material – Chapter 29 West Virginia Coal Mine Permitting Handbook. Charleston, WV.

West Virginia Division of Environmental Protection. 2000. An Evaluation of Future Mining Island Creek Watershed. (unpublished), Charleston, WV.

West Virginia Division of Natural Resources. 1997. Capitol Improvements Plan. Elkins, WV.

West Virginia Division of Environmental Protection. 2000. Postmining Land Use – Chapter 30 West Virginia Coal Mine Permitting Handbook. Charleston, WV.

West Virginia Surface Mining and Reclamation Association. 2000. Making the Most of Reclaimed Mined Land. Green Lands. Vol 30. no. 4.

West Virginia Surface Mining and Reclamation Association. 2000. Post Mining Land Use. Green Lands vol. 30. no 3.

West Virginia University – Natural Resource Analysis Center. 2001. GAP Analysis for West Virginia – Draft Final Report. Morgantown, WV. September.

Workman, Michael, Paul Salstrom and Philip Ross. 1994. Northern West Virginia Coal Fields Historical Context. Institute for History of Technology and Industrial Archeology Technical Report 10. Morgantown, WV.

Report Figures.